REGULATORY OBSERVATION

REGULATOR TO COMPLETE

RO unique no.:	RO-UKHPR1000-0043
Revision:	1
Date sent:	23/11/20
Acknowledgement required by:	30/11/20
Agreement of Resolution Plan Required by:	04/12/20
CM9 Ref:	2020/310262
Related RQ / RO No. and CM9 Ref: (if any)**:**	RQ-UKHPR1000-0653, 2020/94401
Observation title:	ALARP Demonstration for PSA
Lead technical topic: 15. Probabilistic Safety Analysis	**Related technical topic(s):**

Regulatory Observation

Background

The objective of this Regulatory Observation (RO) is to state ONR's expectations regarding the use of PSA to inform the demonstration that the level of risk arising from the design of the UK HPR1000 has been reduced as low as reasonably practicable (ALARP).

If applied correctly, the PSA is a powerful tool to understand the overall level of risk arising from the UK HPR1000 design and to identify if any further safety improvements are possible. This is an important input to the demonstration that risks are reduced ALARP, which requires evaluation of the risks and consideration of whether it would be reasonably practicable to implement further safety measures. As part of the ALARP demonstration ONR expects that plant vulnerabilities highlighted by the PSA, or other areas where improvements could be made in the plant design or operation to reduce the risk, should be clearly identified. This is expected to be done in a systematic, transparent and auditable way and should consider all levels of defence in depth. The output from this review should support a clear conclusion that there are no further reasonably practicable improvements identified for the generic plant design during GDA

ONR has reviewed the report "ALARP Demonstration Report for PSA" [1] and raised RQ-UKHPR1000-0653 [2] as the report did not meet ONR expectations for an adequate ALARP demonstration for PSA. Although the response to RQ-UKHPR1000-0653 has provided some information regarding the requesting party (RP)'s process for the ALARP demonstration, there exists a gap wherein new work is required to meet ONR expectations and provide a suitable and sufficient response during GDA.

Relevant Legislation, Standards and Guidance

ONR's Safety Assessment Principle (SAP) [3] FA.14 states that:

Fault analysis: PSA	Use of PSA	FA.14
PSA should be used to inform the design process and help ensure the safe operation of the site and its facilities.		

Supporting paragraph 661 states that *'Appropriate use of PSA should be made in activities such as: (c) supporting the demonstration that risks are tolerable and ALARP'*

Further guidance is provided in the associated Technical Assessment Guides, including:

- NS-TAST-GD-030 (Ref 3), inspectors must be able to form an opinion on whether risks are ALARP and it is not unreasonable to expect numerical input to the demonstration that the risk is ALARP.

- NS-TAST-GD-051 (Ref 4) provides further guidance on the role of PSA within safety cases and the demonstration of ALARP therein.
- NS-TAST-GD-005 (Ref 5) provides further guidance on the role of PSA in the demonstration of ALARP.

Regulatory Expectations

ONR expects the RP to undertake a systematic, transparent and auditable review of the PSA to identify safety improvements that could reasonably be implemented as part of the overall ALARP demonstration for the generic UK HPR1000 design.

In the context of PSA, the demonstration of ALARP should include both:
- a systematic and comprehensive review of the PSA results, and;
- use of PSA to inform potential modifications identified from elsewhere within the safety case.

This could therefore include:
- A systematic review of the PSA results to identify plant vulnerabilities and other aspects of the plant design where risk informed improvements could be undertaken, for example:
    - Systematic review of minimal cutsets (MCS), initiating events (IEs), system and basic event importance measures to identify plant vulnerabilities and other aspects where risk informed improvements to the design could be undertaken (such as measures to increase defence in depth, reduce initiating event frequencies, increase component or system reliability, increase resilience to hazards etc.)
    - When identified vulnerabilities and other aspects are not judged representative of the plant, due to conservative modelling or assumptions, the level of conservatism could be estimated and information could be provided to the expected stage of design, construction or commissioning at which the conservatism could be removed.
    - The vulnerabilities and other aspects identified could be described to aid understanding, for example describing their risk significance to estimate the potential for risk improvements.
- Use of the PSA to inform optioneering for design changes identified via other means as part of the safety case:
    - Identify any options being considered in other areas that could have a significant impact on the results of the PSA, which have not been identified by review of the PSA results.
    - Risk benefits of the options proposed examined using the PSA

In addition, during GDA, ONR expect the RP to justify the implementation status of potential improvements identified from the above review of the PSA, if not already captured within the RP's existing design change process. Therefore:
- If an option is considered to contribute towards reducing risks to ALARP and is to be incorporated in the UK HPR1000 DR post GDA, justification should be provided for deferring the implementation of the decision. It should be demonstrated that closure of GDA does not preclude the option from being incorporated into the design and that a commitment to consider the implementation of the option in the future has been made. Information should also be provided for the stage of the design process when the implementation will take place.
- Where consideration of options is deferred to a later stage in the design process, this should be justified. Information should be provided for the stage of the design, construction or commissioning in which the option will be considered. It should be demonstrated that closure of GDA does not preclude the option from being incorporated into the design and that a commitment to consider the option in future has been made and recorded as part of GDA.
- Where options are not considered for incorporation into the design, justification should be provided. This should include consideration of the limitations of the PSA and the risk calculated by the PSA.

ONR understands that decisions on aspects of the detailed design may not be possible as part of GDA, however where the PSA insights show that an aspect of the detailed design is risk significant it should be demonstrated that closure of GDA does not preclude risk informed design from taking place later in the design process. Aspects such as room sizing, civil design, heat loads and electrical loads should be taken into account. Wherever possible, ONR expects that suitable design requirements have been included as part of GDA.

References

[1] CGN, ALARP Demonstration for PSA, Rev. A, October 2019, CM9 2019/310135
[2] ONR, RQ-UKHPR1000-0653, PSA Demonstration of ALARP and Optioneering, March 2020, CM9 2020/69812
[3] ONR, Safety Assessment Principles for Nuclear Facilities 2014 Edition, Rev. 1, January 2020, CM9 2019/367414
[4] ONR, NS-TAST-GD-030, Probabilistic Safety Assessment, Rev. 6, June 2019, CM9 2019/408246
[5] ONR, NS-TAST-GD-051, The Purpose, Scope and Content of Safety Cases, Rev. 6, December 2019, CM9 2019/82006
[6] ONR, NS-TAST-GD-005, Guidance on the Demonstration of ALARP, Rev. 10, December 2019, CM9 2019/315236

Regulatory Observation Actions

RO-UKHPR1000-0043.A1 – PSA ALARP demonstration process

In response to this Regulatory Observation Action, GNSL should:

- Develop and document a detailed process for using the PSA and results in a systematic and comprehensive way to identify potential options for design improvement to reduce the risk of the generic UK HPR1000 design to ALARP.
- The response should include both use of the PSA results themselves to identify potential improvements and using the PSA to inform the optioneering of improvements identified through other means.
- If relevant processes are already in place they should be identified.

Resolution required by '*to be determined by General Nuclear System Resolution Plan*'

RO-UKHPR1000-0043.A2 – Use of the PSA results to demonstrate relevent risks are reduced ALARP

In response to this Regulatory Observation Action, GNSL should:

- Use the process developed under Action 1 to systematically and thoroughly use the PSA model and results to identify insights and vulnerabilities of the generic UK HPR1000 design.
- Develop a list of potential options for design improvements to address the insights and vulnerabilities identified. This list should have a clear and suitable scope, focusing on areas where the risk is high. The development of the list of options should be documented in detail.
- Use the PSA model to evaluate the risk reduction of the options identified. The evaluation of options should be documented in detail**.**
- Using the risk reduction analysis, decide which options are reasonably practicable to be incorporated into the UK HPR1000 design. The decision made for each option should be documented in detail, including justification for when an option is not considered for incorporation.
- Demonstrate which changes to the DR should be made prior to completion of GDA, or where this is not possible, how the commitment to make the change could be managed through the next stage of the design process and how closure of GDA does not preclude the options from being considered as part of future risk informed design activities.
- Summarise and document the outcomes from this work, to provide evidence to support the conclusion that there are no further reasonably practicable safety improvements identified for the generic plant design during GDA based upon the PSA results.

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RO-UKHPR1000-0043.A3 – Traceability of the PSA

The overall intent for this Action is for GNSL to provide a demonstration that the PSA is traceable from the thermalhydraulic and physics calculation evidence through to the description of the models in the PSA reports and finally to the PSA models.

In response to this Regulatory Observation Action, GNSL should:

- Identify multiple accident sequences in the Level 1 PSA (ver. B) in which traceability will be demonstrated.
- Using the identified sequences, the progression of the accident sequence needs to be linked to any assumptions, timings or success criteria used to explain the accident sequences. There needs to be clear sign posting to the analysis from which the assumptions, timings or success criteria were derived from.
- Present the evidence (thermal hydraulic analysis/physics or other analyses) that was used to substantiate the demonstrated accidents sequences in enough detail to enable an independent review of evidence supporting the claims and arguments. If this evidence is already contained in extant reports that were previously submitted in GDA, clear referencing to this information is needed. When using extant reports, consistency of the evidence to the information used in the PSA needs to be ensured. If the evidence is in RP reports that were not submitted, then a reproduction of that evidence needs to be included in the response to this Action.
- Provide a strategy and programme for cascading this work through into the next version of the PSA and all future PSA reports, for GDA and beyond.

Resolution required by '*to be determined by General Nuclear System Resolution Plan*'

REQUESTING PARTY TO COMPLETE	
Actual Acknowledgement date:	
RP stated Resolution Plan agreement date:	